DISTRIBUTED INTERACTIVE SIMULATION PROVEN IN FLIGHT TEST AIRCRAFT TRACKING

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INTRODUCTION

With the decline in military budgets worldwide, the need for ever more effective training is becoming apparent. The size of the armed forces is being reduced, so the remaining members have to be trained to be more effective and efficient in doing their jobs. To improve effectiveness and efficiency of performance, military training needs will be increased. Our largest training costs will be in pilot training because of the high cost of keeping aircraft in the air. When we look at the cost of training a pilot to operate in a multiplayer scenario against a large number of unfriendly aircraft and a large number of ground threats, the cost of training is tremendous. It requires a large number of personnel, aircraft and ground equipment to train a limited number of pilots. Our current Red Flag exercises can require as many as 75 aircraft in the air simultaneously plus a large number of ground threats and a large number of support personnel. This can amount to a prohibitive cost to train a limited number of pilots.

DISCUSSION

To reduce this cost the techniques of Distributed Interactive Simulation (DIS) must be applied. DIS technology has existed for about five years and has been successfully applied to army training requirements. Simulation as applied to air combat training is proving its worth in exercises currently being performed. The Advanced Research Project Agency (ARPA)/Army Simulation Network (SIMNET) program demonstrated that allowing combatants in simulators to interact with one another within a common gaming area greatly increases the value of simulator training.[1] In addition the exercises conducted by Armstrong Laboratory's Aircrew Training Division further strengthens the argument for simulator training. Pilots in these exercises reported that the training received from networked simulators was superior to their current unit training for tasks that cannot be practiced in the actual aircraft because of cost, safety, and security restrictions. The real value of DIS technology will be appreciated when it is successfully applied to air combat training.

Currently in an air combat training scenario real aircraft are flown against real aggressor aircraft and real targets on the ground. Because of the cost of the real aggressor aircraft and the real emitting threats, the full number of aggressors and threats which might be experienced in a real operation cannot be provided, therefore, training compromises must be made. As we continue to make training more realistic, the costs will skyrocket if we do not find a substitute for using real threat aircraft, real ground threats, and groups of training aircraft all operating at the same time. The cost of this ever-increasing training problem can be reduced by the effective application of DIS technology.

It has already been demonstrated that data from real flying aircraft can be combined with simulated aircraft and displayed in a simulator where two aircraft are simulated and two aircraft are real all flying in formation. This was demonstrated in May of 1993 when two F-18 aircraft were equipped with IEC RAJPO GPS instrumentation pods. These aircraft were then flown on the Echo Range at China Lake, California. The GPS position data was data linked from the pods to a ground station and subsequently sent over land line to the Northrop Flight Simulation Laboratory in Hawthorn, California. At the Flight Simulation Laboratory simulated aircraft were then flown in formation with the real aircraft, thus combining the real and virtual worlds. There is no reason why this situation cannot be reversed where the pilot flying the real aircraft can view simulated aggressor aircraft on his heads-up display where the simulated information is uplinked to the real aircraft. In the same manner simulated ground threat data could also be uplinked to the real aircraft. Using these techniques, the number of simulated aggressor aircraft and ground threats could be increased without materially increasing the cost of the training exercise. Carrying this to the extreme, eventually it will be theoretically possible to “fly” a complete training operation in a simulator without having to fly any real aircraft at all except for the pilot to feel the environmental effects of his maneuvers. This of course defeats the objective of training the pilot and his support crew in the physical aspects of the training mission. The pilot must retain his basic ability in flying the aircraft while the support personnel must retain their efficiency in aircraft maintenance techniques. Therefore, training can never be relegated to the simulator alone, but rather simulator techniques are used to augment the training mission and provide inputs that are prohibitively expensive to provide physically.

One of the more significant advantages of applying DIS technology is that of data transmission bandwidth limitation. For example, it has been shown that through the application of dead reckoning techniques sample rates of position data required to track a high dynamic aircraft through extreme maneuvers can be significantly reduced.[2] This technique is commonly used in DARPA SIMNET applications. A dead reckoning model of player position is carried both in the player and at the ground control site. By using a precise positioning source, such as GPS, the player can determine its exact state vector and transmit it to the ground. If the player maintains course and speed, he easily updates his position by the dead reckoning models both on the vehicle and on the ground, making continuous transmission of position data unnecessary. Limits are established on the vehicle dead reckoning model so that whenever the actual position of the vehicle, as determined by GPS, differs from the computed model by more than 1 meter, for example, the model is corrected, and the new position data is also transmitted to the ground. Position data is, therefore, transmitted from the vehicle only when required, not continuously at an artificially high rate. For example, during low activity such as level flight, position data might be transmitted at a low rate such as one sample per second, but when the aircraft begins violent maneuvers the sample rate would increase to perhaps 30 times per second or more. Then when the aircraft returns to level flight, the data sample rate would be reduced. This concept has been studied using actual data taken from violently maneuvering aircraft. Updating the position and orientation of remote vehicles at extremely high sample rates to achieve remote vehicle position and orientation accuracies has been proven unnecessary to achieve fully effective training and engineering accuracies. Other data reduction techniques aimed at extracting the significant information from a data set rather than transmitting all the raw data can significantly reduce the data transmission bandwidth required.

CONCLUSION

The training instrumentation systems being planned today are beginning to recognize the advantages of applying DIS technology to their programs. The ability to combine real and simulated data in a training exercise greatly reduces training costs. For example, the U.S. Navy's TCTS Program specifically calls for the application of DIS technology. This is of particular importance in the TCTS Program where a complete battle group must be trained simultaneously. The number of air and ground threats to be experienced far exceeds the capability to provide real threats at a remote location in real time. Therefore, simulated threats are mandatory to conduct a meaningful training exercise.

REFERENCES

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[2] Harvey E., Schaffer R., and Waters R., "Is distributed interactive simulation technology adequate for aviation tactical team training?," BBN Systems and Technologies, Cambridge,Massachusetts.